



TRINITY COLLEGE FOR WOMEN NAMAKKAL

Department of Chemistry

ALKALOIDS

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ORGANIC CHEMISTRY

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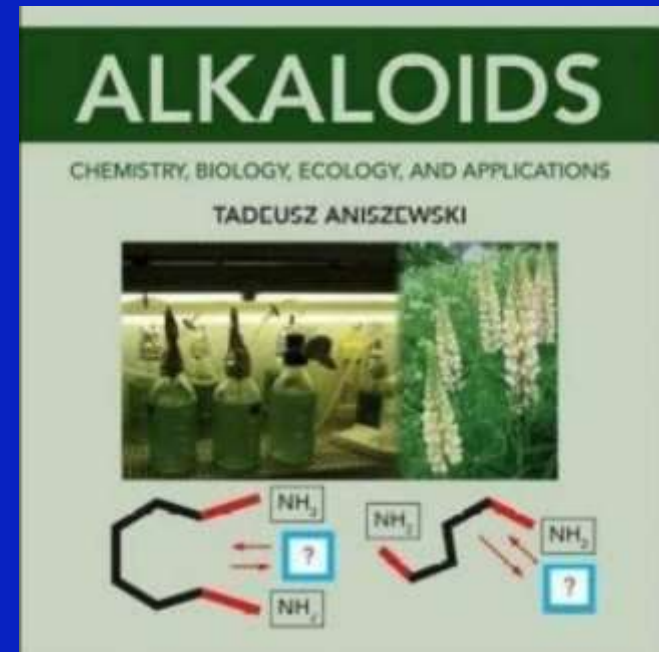
ALKALOIDS

The term Alkaloids was proposed by W.Meissnerin in 1819 for basic nitrogen containing compounds of plant origin. It may be defined as physiologically active basic compounds of plant origin in which at least one nitrogen atom form part of a cyclic system.

Alkaloids are cyclic organic compounds containing nitrogen in a negative state of oxidation with limited distribution among living organisms.

FROM OF ALKALOIDS

- Free bases
- Salts with Organic acids e.g.oxalic,acetic acids
- Salts with inorganic acids e.g.Hcl,H2So4`
- Salts with special acids e.g.Meconic acid in opium
- Glycosidal form e.g.solanine in solanum



PHYSICAL PROPERTIES

1)CONDITION:

- ❖ Most alkaloids are crystalline solids.
- ❖ Few alkaloids are amorphous solids.
- ❖ Few alkaloids are amorphous solids.e.g.emetine.
- ❖ Some are liquids that are either:Volatilee.g.nicotine and coniine or Non-volatile e.g.hyoscine and pilocarpine.

2)COLOUR

- ❖ The majority of alkaloids are colourless but some are coloured.

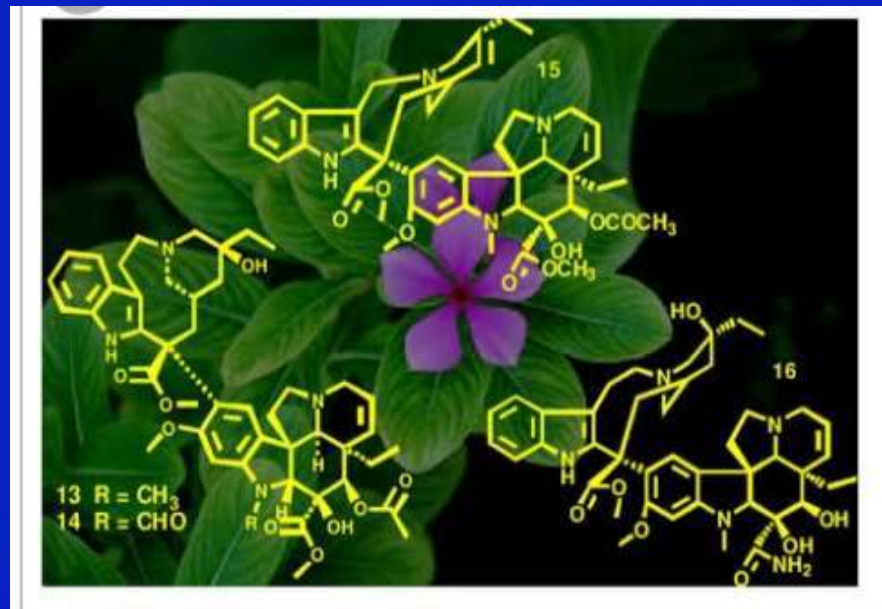
3)SOLUBILITY

- ❖ Both alkaloids bases and their salts are soluble in alcohol.
- ❖ Generally,the bases are soluble in organic solvent and insoluble in water.
- ❖ Bases soluble in water:caffeine,codeine,colchine and quaternary ammonium bases.
- ❖ Bases insoluble or sparingly soluble in certain organic solvents:morphine in ether,theobromine in benzene.

- ❖ Salts are usually soluble in water and insoluble or sparingly soluble in organic solvent.
- ❖ Salts insoluble in water : quinine monosulphate.
- ❖ Salts soluble in organic solvent : lobeline and apotropine hydrochlorides are soluble in chloroform.

4) ISOMERIZATION

- ❖ Optically active isomer may show different physiological activities.
- ❖ The racemic (optically inactive) dl-atropine is physiologically active.



CHEMICAL PROPERTIES

1) BASICITY



Saturated hexacyclic amine is more basic than aromatic amines.

According to basicity alkaloids are classified into:

- 1) Weak bases e.g. caffeine
- 2) Strong bases e.g. atropine

2) OXYGEN

Most alkaloids contain oxygen and are solid in nature e.g. atropine

Some alkaloids are free from oxygen and are mostly liquids.

e.g. Nicotine, Coniine.

3) STABILITY

EFFECT OF HEAT

Alkaloids are decomposed by heat, except strychnine and caffeine

REACTION WITH ACID

- 1) Salt formation
- 2) Dil acids hydrolyse ester alkaloid e.g. Atropine

NOMENCLATURE

Trivial names should end by "ine".

The genus of the plant , such as atropine from *Atropa belladonna*.

EXTRACTION AND ISOLATION OF ALKALOID

On the properties, alkaloid can be isolated from the plant material:

1) Alkaloid from salt with aqueous mineral acid which when treated with base free alkaloid is liberated.

2) Free alkaloids are soluble in organic solvent where as the alkaloidal salt soluble in water.

For this purpose the plant material is dried and crushed into powder and then extracted. In nature most of the alkaloids remain in free form . But some of them also remain in salt form

There are a number of method to extract alkaloids :

Process-A

1) Plant material moistened with water and mixed with lime or NH_4OH to get free most of the alkaloids. These material are then extracted with organic solvent such as chloroform.

2) The concentrated organic layer containing the free alkaloids treated with aqueous mineral acid and allowed to separate. So the salts are now in aqueous layer, where many impurities remain behind in the organic layer.

3) The aqueous layer containing the salt of alkaloids is treated with base to set free from of alkaloids and shaken with organic solvent such as chloroform, so free alkaloid is separated out in chloroform layer and evaporated to get crude alkaloids, the process repeated three times to get free alkaloids.

PLANT MATERIAL

↓ Extract with water and lime or aqueous OH

SALT OF ALKALOID IN AQUEOUS LAYER

↓ Extract with organic solvent

SALT OF ALKALOIDS IN AQUEOUS LAYER

IMPURITIES IN CHCl₃ LAYER

↓ Treated with base

FREE ALKALOID

↓ Extract with organic solvent

CRUDE ALKALOIDS



Process B:

The plant material is extracted with water or aqueous alcohol containing HCl acid. The aqueous layer is then extracted with organic solvent such as CHCl_3 to remove pigment and other unwanted substances which is soluble in that solvent. The aqueous layer is then treated with ammonia to get the alkaloid free which is then separated by shaking with organic solvent.

PLANT MATERIAL

↓ Moistened with water

FREE ALKALOID+SALT+ANY COMPOUND

↓ Extract with organic solvent

ORGANIC LAYER CONTAINING FREE ALKALOID

↓ Shake with aqueous acid

SALT OF ALKALOID IN AQUEOUS LAYER

IMPURITIES IN CHCl_3 LAYER

↓ Treated with base

FREE ALKALOID

↓ Extracted with organic solvent

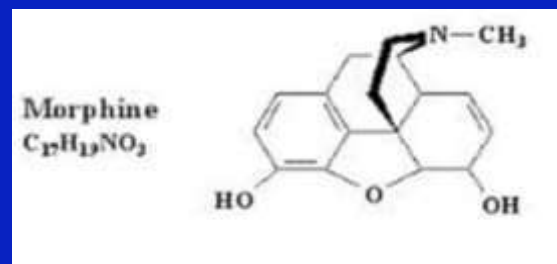
CRUDE ALKALOID

CLASSIFICATION OF ALKALOID

There are many system of classification of alkaloids
Most common classification

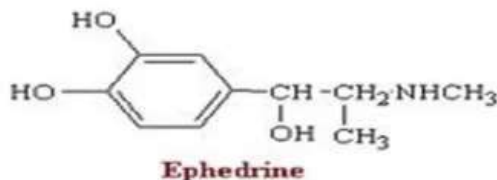
A. TRUE ALKALOID:

These are toxic , show a wide range of physiological activity and contain nitrogen in a heterocyclic ring . They are derived from amino acid and normally occur in plants.e.g.Morphine



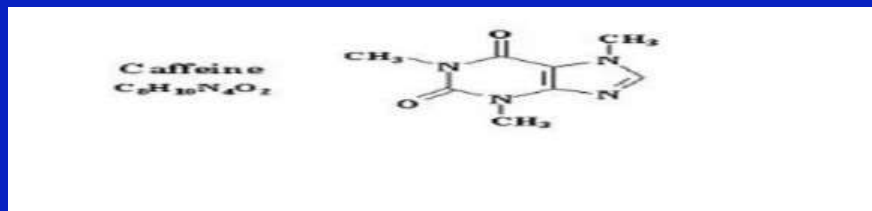
B. PROTO ALKALOID:

These are relatively simple amine in which the amino acid nitrogen is not in a heterocyclic ring.e.g.Ephedrine



C. PSEUDO ALKALOID:

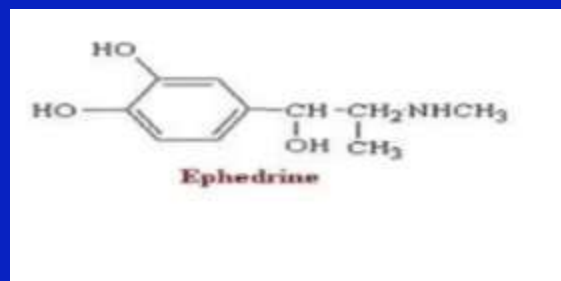
These are not derived from amino acid precursors and are usually basic in nature . e.,g.purine alkaloids



Chemical classification

According to the nature of basic chemical structure, alkaloids are divided into two broad groups:

A typical or photo or non-heterocyclic alkaloid: A typical alkaloids are those which contain nitrogen atom in form of amine in the branched chain of the structure. They are also called biological amine

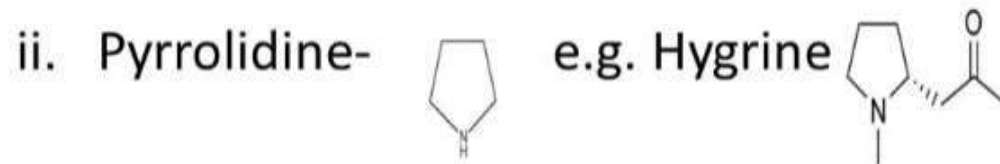
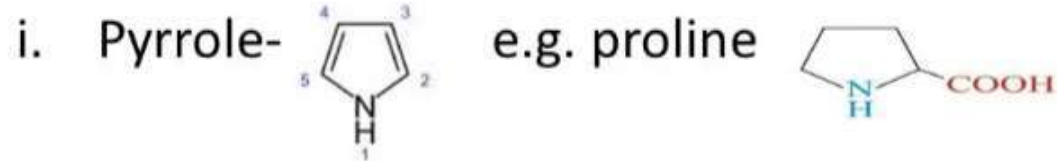


Typical alkaloid

These contain nitrogen in a cyclic ring of the molecular structure and all basic properties of alkaloids. These are as follows-

✓ Pyrrole- eg. Proline

✓ Pyrrolidine- eg, Hygrine

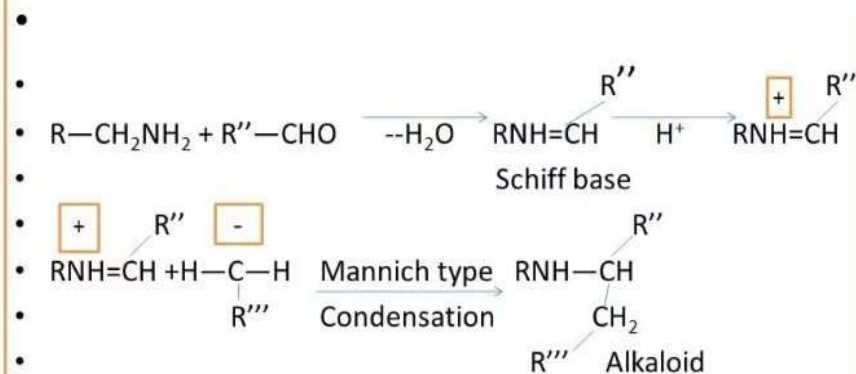
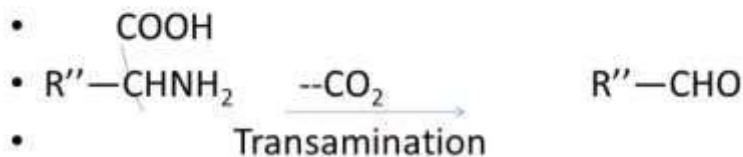
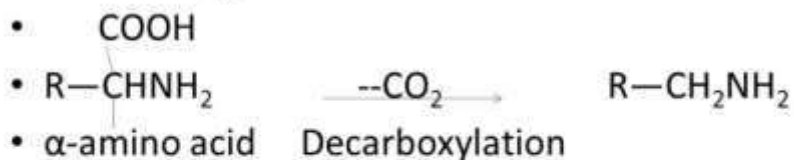


Describe the biosynthesis of alkaloid

The biosynthesis of many alkaloid structures can be rationalized through simple chemical reactions that involve amino acids. The amino acids that most often serve as alkaloid precursors include phenylalanine, tyrosine, tryptophan, histidine, anthranilic acid, lysine and ornithine.

The general reactions which is important for the biosynthesis of alkaloid include the de-carboxylation and transamination of the amino acids to yield a corresponding amine or aldehyde. These can react to form a Schiff base which in turn can react with a carbanion in Mannich type condensation-

- Mannich type condensation-



Coffee

Synonym: Coffea

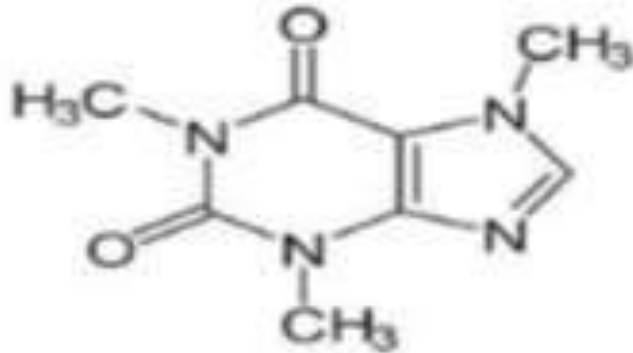
B.S.: Coffe bean or coffee seed is the dried ripe seed to Coffea arabica

Family: Rubiaceae

G.S.: The plant is indigenous to Ethiopia and other parts of Eastern Africa and is widely cultivated in Indonesia, Srilanka and Brazil.

Constituents: Beans contain Oil, wax, caffeine, aromatic oil, tannic acid, caffetannic acid, gum, sugar, protein.

Caffeine



Use

People drink coffee to relieve mental and physical fatigue and to increase mental alertness.

Coffee is also used to prevent Parkinson's disease, gallstones, type 2 diabetes, gastrointestinal cancer, lung cancer, and breast cancer.

Other uses include treatment of headache, low blood pressure, obesity, and attention deficit-hyperactivity disorder

Decaffeinated coffee

Decaffeinated coffee is prepared by extracting most of the caffeine from the coffee bean yet retaining the pleasant aroma of coffee. Such preparation usually contains 0.085% caffeine

Use: Acts as stimulant; diuretic; in CNS depressant poisoning

Use

Theophylline and Theobromine are used as smooth muscle relaxant and diuretic

The chief use of tea is as a source of caffeine which has a marked stimulating action on the CNS, kidney, muscle and heart

Processing of tea

There are two types of tea on the basis of their processing:

Green tea: It is prepared by in China and Japan by rapidly drying the freshly picked leaves in copper pan over a mild artificial heat. The leaves are often rolled in the palm of the hand as they dry.

Black tea: It is prepared in Srilanka and India by heaping the fresh leaves until fermentation has begun. They are then rapidly dried with artificial heat.

THANK YOU

<http://www.trinitycollegenkl.edu.in/>